

Theory of relativity, causality, the Scharnhorst effect and the speed of light.

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A. Einstein's special theory of relativity is a fundamental physical theory and its truth is beyond doubt. STR is essentially Newtonian mechanics, but taking into account the existence of the maximum speed of movement in the Universe.

The second postulate of the theory of relativity (the principle of constancy of the speed of light) expresses the principle of causality. That is, if we accept that there is causality in the Universe, then this automatically means that there is a maximum speed of interaction in the Universe. In the theory of relativity, the maximum speed is initially equal to the speed of light in vacuum.

Einstein used light signals in his thought experiments. But, to justify STR, light signals are not required, since STR is more general and applicable to all types of interactions. STR requires only the presence of the maximum speed in the Universe, and the numerical value can be even more - the theory will not change from this.

It should be clearly understood that the postulation of the same speed of light in all inertial reference frames means that we postulate the speed of light in vacuum as the maximum speed in the Universe. If this is not so, then in the theory of relativity it is simply necessary to change the corresponding constant.

Therefore, if an object is experimentally fixed that moves faster than the speed of light in vacuum (for example, galaxies), then this means that in the Universe there is a greater maximum speed of interaction transfer than the speed of light.

A similar conclusion also follows from the Casimir effect [1, 2]. Recall that based on quantum field theory, virtual particles and antiparticles are born and annihilate in vacuum. This means that in vacuum there is a pressure of virtual photons, which slows down a real photon.

Consequently, if such pressure is reduced, then the speed of light in the new vacuum (this is the Casimir vacuum) will be greater than the speed of light in ordinary vacuum. This phenomenon is called the Scharnhorst effect - it is not confirmed experimentally, but predicted theoretically [3]. The Casimir effect was experimentally fixed, from which the Scharnhorst effect logically follows.

Theoretically, if all virtual photons are somehow “removed” from the vacuum, then the speed of light in such a Newtonian vacuum will be enormous. In this case, we are actually postulating that the maximum speed in the Universe is the speed of light in a vacuum with zero energy, and not in the vacuum of the lowest (ground) energy state of the quantum field.

And it is right. Since otherwise, when overcoming the speed of light in a vacuum, the principle of causality must be violated. It's impossible. Therefore, there must be an interaction transfer rate that exceeds the speed of light in the physical vacuum. To get ahead of future effects like the Scharnhorst effect, it is logical to assume that this is the speed of light in a Newtonian vacuum.

If the Scharnhorst effect is fixed experimentally, then this will mean fundamentally overcoming the speed of light in a vacuum, which means that we are forced to admit that the maximum speed in the Universe is the speed of light in a Newtonian vacuum (vacuum with zero energy, “empty” vacuum).

Therefore, it is quite reasonable to assume that the maximum rate of transmission of interaction in the Universe is the speed of light in the Newtonian vacuum. Moreover, it will be much greater than the usual speed of light. Then the physical vacuum can be considered an ordinary medium (remember the concept of the space-time continuum) like a transparent liquid, which means that particles with a certain energy will be able to overtake light.

Everything will be like in the Vavilov-Cherenkov effect [4], when a relativistic particle moves faster than the speed of light in a given medium and emits light, just as a particle moving faster than the speed of sound emits sound.

It is interesting that if a particle or an alien ship overcomes the light barrier in a vacuum, then they will emit light, moreover, in a hard range. That is, hard gamma rays will be emitted. Perhaps gamma-ray bursts are the “trace” from superlight...

Perhaps the Universe really “boils” with life... and there really are travels between galaxies.

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